Application No. 10/645,349
Response to Office Action of March 6, 2006

REMARKS / ARGUMENTS

The present application includes pending claims 1-33. Claims 10-33 have been rejected. Claims 1-9 have been allowed. Claim 20 has been amended. The Applicants respectfully submit that the claims define patentable subject matter.

Claims 20-28 remain rejected under 35 U.S.C. 102(b) as being anticipated by IDS document Rouphael (hereinafter, Rouphael). Claims 10-33 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Rouphael in view of U.S. Patent 5,955,991 issued to Kawakubo (hereinafter, Kawakubo). Claims 10-19 are rejected under 35 U.S.C. § 103(a) as being unpatentable over IDS document Klukas (hereinafter, Klukas) in view of Kawakubo. The Applicants respectfully traverse these rejections at least for the reasons previously set forth during prosecution and the following remarks.

I. The Combination of Rouphael and Kawakubo Does Not Anticipate Claims 10-33

The Applicants first turn to the rejection of claims 10-33 under 35 U.S.C. 103(a) as being as being unpatentable over Rouphael in view of Kawakubo.

With regard to an obviousness rejection, MPEP 2142 states that in order for a prima facie case of obviousness to be established, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Further, MPEP 2143.01 states that "the mere fact that references can be combined or modified does not render the resultant combination obvious unless

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the prior art suggests the desirability of the combination," and that "although a prior art device 'may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so'" (citing In re Mills, 916 F.2d 680, 16 USPQ 2d 1430 (Fed. Cir. 1990)). Moreover, MPEP 2143.01 also states that the level of ordinary skill in the art cannot be relied upon to provide the suggestion...," citing Al-Site Corp. v. VSI Int'l Inc., 174 F.3d 1308, 50 USPQ 2d 1161 (Fed. Cir. 1999).

Rouphael discloses "a spatial interpolation algorithm for the upsampling...of uniform linear arrays (ULAs)...to enhance performance of a code division multiple access (CDMA) cellular antenna system." See Rouphael at Abstract. More specifically, Rouphael teaches that "the ULA is interpolated to within the spatial Nyquist rate...by placing a virtual antenna element half way in between every two real adjacent antenna elements." See id. Furthermore, Rouphael discloses a ULA interpolation algorithm and how the ULA interpolation algorithm may be used as a pre-processing procedure. See Rouphael at page 531, Section I, 3rd paragraph. In addition, Kawakubo discloses "a cheap digital beamforming radar apparatus...the invention comprises a transmit section, ..., an array antenna, ..., a switching device, ..., a receive section for downconverting, ..., and a digital signal processing section." See Kawakubo at Abstract.

A.   The Examiner's Response Mischaracterizes Applicants' Arguments With Regard to Claim 10

With regard to Applicants' arguments stated on pages 13-15 of the February 17, 2006 response, the Office Action states:

> Firstly, applicant argues there is not necessarily one signal processing chain for each of the M antenna elements (p. 14, 4th ¶). A secondary reference has been added to show this would have been obvious.

See the Office Action, page 2.

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The Applicants are confused as to how the Office Action could mischaracterize the Applicants' argument in such a manner. In the February 17, 2006 response, the Applicants argue that *it is not inherent that an array processing module* must be present in Rouphael, with M signal processing chains, one for each of all of the M antenna elements. *See* February 17, 2006 response, page 14. The Applicants submit that a rejection based on inherency must include a statement of the rationale or evidence tending to show inherency, as required by MPEP at § 2112. The Office Action, however, does not include any rationale or evidence tending to show inherency with respect to the "array processing module" limitation of independent claim 10, including limitations introduced by the "wherein" clause of claim 10. Put another way, *the Office Action does not illustrate how an "array processing module" with the specific characteristics and limitations as stated in claim 10, is inherent or obvious.* The Applicants further disagree, as explained herein below, that the second reference, Kawakubo, used by the Office Action proves obviousness, as stated in the Office Action (page 2).

With regard to Applicants' arguments stated on pages 13-15 of the February 17, 2006 response, the Office Action further states:

> Secondly, applicant argues "it is also not inherent that an array processing module must be present in Rouphael **where** the array processing module generates N signal responses using all of the generated M replicas of the received signal." This is unclear in that it states it is unnecessary that the array processing module is present **when** the array processing module generates something.

See the Office Action, page 2 (emphasis added). The Office Action makes a similar statement with regard to Applicants' arguments stated on pages 21-24 of the February 17, 2006 response. *See id.*, page 4.

It seems that the Office Action is again mischaracterizing the Applicants' argument since the Applicants' argument in the above sentence uses the word

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"where" and not "when", as interpreted by the Examiner. Clearly, "where" is used to signify "having the properties of" with regard to the additional limitations of the "array processing module," as stated in claim 10. The Office Action does not include any rationale or evidence tending to show inherency with respect to the "array processing module" limitation of independent claim 10, including limitations introduced by the phrase "where the array processing module generates N signal responses using all of the generated M replicas of the received signal," as stated in claim 10. Put another way, *the Office Action does not illustrate how an "array processing module" with the specific characteristics and limitations as stated in claim 10, is inherent or obvious.*

With regard to Applicants' arguments stated on pages 13-15 of the February 17, 2006 response, the Office Action further states:

> The second half of the sentence appears to say that it is not necessarily the case that all of the M replicas of the received signal are used. However, Rouphael discloses that the odd numbered ones of the N new set of signals are the M received signals (p. 532, col. 2, 1st ¶). Thus, all of the M generated replicas are used to form the N new set of signals.

See the Office Action, page 2.

The Applicants would like to point out that the Febraury 17, 2006 response uses the phrase "where the array processing module generates N signal responses using all of the generated M replicas of the received signal" to indicate a limitation of the array processing module, as claimed in claim 10. In the February 17, 2006 response, the Applicants argue that *it is not inherent that an array processing module* where the array processing module generates N signal responses using all of the generated M replicas of the received signal, must be present in Rouphael, with M signal processing chains, one for each of all of the M antenna elements. *See* February 17, 2006 response, page 14. In this regard, the

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Office Action does not illustrate how an "array processing module" with the specific characteristics and limitations as stated in claim 10, is inherent or obvious.

The Applicants further submit that Rouphael does not disclose that "N new set of signals are the M received signals," as stated in the Office Action at page 2. Rouphael discloses that N is the number of identical and omnidirectional sensors, and M is the number of narrowband plane waves impinging on a corresponding one of the N sensors. *See* Rouphael, page 531, column 2, 3rd and 4th ¶.

B.   Rejection of Independent Claim 10 under 35 U.S.C. § 103 (a)

With regard to the rejection of independent claim 10 as being unpatentable over Rouphael in view of Kawakubo, the Applicants submit that the combination of Rouphael and Kawakubo does not disclose or suggest at least the limitation of "an array processing module including M signal processing chains ... coupled to one of the M physical antenna elements...the array processing module is configured to generate N signal response values for the antenna array as a function of the M replicas of the received signal...the N signal response values include at least one virtual antenna response value...N is greater than M," as claimed by the Applicants in independent claim 10.

The Examiner states in the Office Action that "Rouphael fails to disclose an array processing module including M signal processing chains, wherein the signal processing chains are coupled to the M physical antenna elements." *See* the Office Action, page 7. The Applicants respectfully agree. Furthermore, Kawakubo does not disclose or suggest at least the limitation of an array processing module, as described in claim 10. Referring to Figure 1 and Figure 5 of Kawakubo, Kawakubo discloses a signal processing chain comprising an RF amplifier 41, a mixer 42, an amplifier 43, a filter 44, an A/D converter 45, and switching signal oscillator 46. *See* Kawakubo, column 5, lines 16-25 and 47-61. Clearly, the signal processing chain disclosed by Kawakubo is to perform downconversion.

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Therefore, Kawakubo does not disclose or suggest the array processing module and related functionality disclosed in claim 10.

C.   Rejection of Independent Claim 20 under 35 U.S.C. § 103 (a)

With regard to the rejection of independent claim 20 as being unpatentable over Rouphael in view of Kawakubo, the Applicants submit that the combination of Rouphael and Kawakubo does not disclose or suggest at least the limitation of "means for generating, as a function of the responses of the M physical antenna elements to the signal, N responses to the signal, respectively associated with N spatial locations along the antenna array, wherein at least one of the N spatial locations is not coincident with a location of any of the M physical antenna elements, and is placed at a non-equidistant location between two successive physical antenna elements," as claimed by the Applicants in independent claim 20.

The Examiner states in the Office Action that "Rouphael fails to disclose an array processing module including M signal processing chains, wherein the signal processing chains are coupled to the M physical antenna elements." *See* the Office Action, page 7. The Applicants respectfully agree. Furthermore, Kawakubo does not disclose or suggest at least the limitation of a means for generating N responses to the signal, as described in claim 20. Referring to Figure 1 and Figure 5 of Kawakubo, Kawakubo discloses a signal processing chain comprising an RF amplifier 41, a mixer 42, an amplifier 43, a filter 44, an A/D converter 45, and switching signal oscillator 46. *See* Kawakubo, column 5, lines 16-25 and 47-61. Clearly, the signal processing chain disclosed by Kawakubo is to perform downconversion. Therefore, Kawakubo does not disclose or suggest "the means for generating, as a function of the responses of the M physical antenna elements to the signal, N responses to the signal, respectively associated with N spatial locations along the antenna array, wherein at least one of the N spatial locations is not coincident with a location of any of the M physical antenna elements, and is

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placed at a non-equidistant location between two successive physical antenna elements," as disclosed in claim 20.

D.   Rejection of Independent Claim 29 under 35 U.S.C. § 103 (a)

With regard to the rejection of independent claim 29 as being unpatentable over Rouphael in view of Kawakubo, the Applicants submit that the combination of Rouphael and Kawakubo does not disclose or suggest at least the limitation of "an array processing module comprising M signal processing chains ...and an interpolation module," as claimed by the Applicants in independent claim 29.

The Examiner states in the Office Action that "Rouphael fails to disclose an array processing module including M signal processing chains, wherein the signal processing chains are coupled to the M physical antenna elements." *See* the Office Action, page 7. The Applicants respectfully agree. Furthermore, Kawakubo does not disclose or suggest at least the limitation of an array processing module comprising M signal processing chains and an interpolation module, as described in claim 29. Referring to Figure 1 and Figure 5 of Kawakubo, Kawakubo discloses a signal processing chain comprising an RF amplifier 41, a mixer 42, an amplifier 43, a filter 44, an A/D converter 45, and switching signal oscillator 46. *See* Kawakubo, column 5, lines 16-25 and 47-61. Clearly, the signal processing chain disclosed by Kawakubo is to perform downconversion. Therefore, Kawakubo does not disclose or suggest the an array processing module comprising M signal processing chains and an interpolation module, as disclosed in claim 29.

E.   Rejection of Dependent Claims 11-19, 21-28, and 30-33

Based on at least the foregoing, the Applicants believe the rejection of independent claims 10, 20, and 29 under 35 U.S.C. § 103(a) as being anticipated by Rouphael in view of Kawakubo has been overcome and request that the rejection be withdrawn. Additionally, claims 11-19, 21-28, and 30-33 depend from independent claims 10, 20, and 29, respectively, and are, consequently, also

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respectfully submitted to be allowable.

II.   The Combination of Klukas and Kawakubo Does Not Anticipate Claims 10-19

The Applicants now turn to the rejection of claims 10-19 under 35 U.S.C. 103(a) as being as being unpatentable over Klukas in view of Kawakubo.

With regard to an obviousness rejection, MPEP 2142 states that in order for a prima facie case of obviousness to be established, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Further, MPEP 2143.01 states that "the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art suggests the desirability of the combination," and that "although a prior art device 'may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so'" (citing In re Mills, 916 F.2d 680, 16 USPQ 2d 1430 (Fed. Cir. 1990)). Moreover, MPEP 2143.01 also states that the level of ordinary skill in the art cannot be relied upon to provide the suggestion...," citing Al-Site Corp. v. VSI Int'l Inc., 174 F.3d 1308, 50 USPQ 2d 1161 (Fed. Cir. 1999).

Klukas discloses "angle of arrival (AOA) estimation utilizing the MUltiple Signal Identification and Classification (MUSIC) algorithm...for land vehicle location systems." See Klukas at Abstract. More specifically, Klukas discloses the use of MUSIC "to estimate the AOA of individual arrivals as well as that of a cluster of arrivals." See id. In addition, Kawakubo discloses "a cheap digital

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beamforming radar apparatus...the invention comprises a transmit section, ..., an array antenna, ..., a switching device, ..., a receive section for downconverting, ..., and a digital signal processing section." *See* Kawakubo at Abstract.

A.   Rejection of Independent Claim 10 under 35 U.S.C. § 103 (a)

With regard to the rejection of independent claim 10 as being unpatentable over Klukas in view of Kawakubo, the Applicants submit that the combination of Klukas and Kawakubo does not disclose or suggest at least the limitation of "an array processing module including M signal processing chains ... coupled to one of the M physical antenna elements...the array processing module is configured to generate N signal response values for the antenna array as a function of the M replicas of the received signal...the N signal response values include at least one virtual antenna response value...N is greater than M," as claimed by the Applicants in independent claim 10.

The Examiner states in the Office Action that "Klukas fails to disclose an array processing module including M signal processing chains, wherein the signal processing chains are coupled to the M physical antenna elements." *See* the Office Action, page 9. The Applicants respectfully agree. Furthermore, Kawakubo does not disclose or suggest at least the limitation of an array processing module, as described in claim 10. Referring to Figure 1 and Figure 5 of Kawakubo, Kawakubo discloses a signal processing chain comprising an RF amplifier 41, a mixer 42, an amplifier 43, a filter 44, an A/D converter 45, and switching signal oscillator 46. *See* Kawakubo, column 5, lines 16-25 and 47-61. Clearly, the signal processing chain disclosed by Kawakubo is to perform downconversion. Therefore, Kawakubo does not disclose or suggest the array processing module and related functionality disclosed in claim 10.

B.   Rejection of Dependent Claims 11-19

Based on at least the foregoing, the Applicants believe the rejection of

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independent claim 10 under 35 U.S.C. § 103(a) as being anticipated by Klukas in view of Kawakubo has been overcome and request that the rejection be withdrawn. Additionally, claims 11-19 depend from independent claim 10, and are, consequently, also respectfully submitted to be allowable.

III.   Rouphael Does Not Anticipate Claims 20-28

The Applicants now turn to the rejection of claims 20-28 under 35 U.S.C. 102(b) as being anticipated by Rouphael. With regard to the anticipation rejections under 102(b), MPEP 2131 states that "[a] claim is anticipated only if *each and every element* as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." See Manual of Patent Examining Procedure (MPEP) at 2131 (internal citation omitted). Furthermore, "[t]he identical invention must be shown in as complete detail as is contained in the ... claim." See id. (internal citation omitted).

Rouphael discloses "a spatial interpolation algorithm for the upsampling...of uniform linear arrays (ULAs)...to enhance performance of a code division multiple access (CDMA) cellular antenna system." See Rouphael at Abstract. More specifically, Rouphael teaches that "the ULA is interpolated to within the spatial Nyquist rate...by placing a virtual antenna element half way in between every two real adjacent antenna elements." See *Id.* Furthermore, Rouphael discloses a ULA interpolation algorithm and how the ULA interpolation algorithm may be used as a pre-processing procedure. See Rouphael at page 531, Section I, 3rd paragraph.

A.   Rejection of Independent Claim 20

The Applicants submit that Rouphael does not disclose or suggest at least the limitation of "means for generating, as a function of the responses of the M physical antenna elements to the signal, N responses to the signal, respectively

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associated with N spatial locations along the antenna array, wherein at least one of the N spatial locations is not coincident with a location of any of the M physical antenna elements, and is placed at a non-equidistant location between two successive physical antenna elements," as claimed by the Applicants in independent claim 20. Rouphael discloses upsampling of an array to within the spatial Nyquist rate by placing a virtual sensor *half way in between every two real adjacent sensors* (i.e., the virtual sensor is placed equidistantly). *See* Rouphael, page 531, column 2, 1st ¶). In this regard, Rouphael does not disclose or suggest "means for generating, as a function of the responses of the M physical antenna elements to the signal, N responses to the signal, respectively associated with N spatial locations along the antenna array, wherein at least one of the N spatial locations is not coincident with a location of any of the M physical antenna elements, and is placed at a non-equidistant location between two successive physical antenna elements," as claimed by the Applicants in claim 20.

B.   Rejection of Dependent Claims 21-28

Based on at least the foregoing, the Applicants believe the rejection of independent claim 20 under 35 U.S.C. § 102(b) as being anticipated by Rouphael has been overcome and request that the rejection be withdrawn. Additionally, claims 21-28 depend from independent claim 20, and are, consequently, also respectfully submitted to be allowable.

IV.   Allowable Subject Matter

The Applicants acknowledges with appreciation the Examiner's allowance of claims 1-9.

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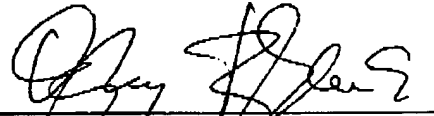Response to Office Action of March 6, 2006

CONCLUSION

Based on the foregoing, the Applicants believe that all claims 1-33 are in condition for allowance. If the Examiner disagrees, the Applicants respectfully request a telephone interview, and request that the Examiner telephone the undersigned attorney at (312) 775-8176.

The Commissioner is hereby authorized to charge any additional fees or credit any overpayment to the deposit account of McAndrews, Held & Malloy, Ltd., Account No. 13-0017.

A Notice of Allowability is courteously solicited.

Respectfully submitted,

Date: April 4, 2006

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